

OBSERVATIONS ON THE BREEDING HABITS OF SOME FRESH WATER FISHES IN THE PUNJAB.

BY

M. HAMID KHAN, M. SC., F.R.M.S.,
Superintendent of Fisheries, Punjab.

(With two plates.)

The observations on the breeding habits of *Cyprinidæ* and *Siluridæ* were carried on in their natural spawning grounds from 1921-1923, while of *Ophiocephalidæ* were recorded from Departmental ponds at Madhopur and Sirkian. The measurements and weight of gravid females were taken and the total number of eggs obtained by weighing the whole mass and then weighing a small portion carefully and counting it as a basis for a calculation.

Species of fish.	Weight.	Number of eggs.	Number of eggs per lb. (40 tolas) of weight.
	Tolas.		Approx.
<i>Labeo rohita</i>	410	19,05,000	1,85,854
<i>Labeo calbasu</i>	120	4,86,600	1,62,200
<i>Labeo calbasu</i>	160	7,39,400	1,84,850
<i>Labeo gonius</i>	18	2,900	6,444
<i>Labeo microphthalmus</i>	19	3,400	6,105
<i>Cirrhina mirgala</i>	132½	2,16,800	65,450
<i>Cirrhina mirgala</i>	80	1,24,800	62,400
<i>Cirrhina reba</i>	17	3,200	7,530
<i>Catla catla</i>	452	4,00,275	35,378
<i>Rita rita</i>	40	20,800	20,800

Determination of the reproductive powers is not only useful from a theoretical point of view but it is of immense importance in the practical question of fish culture. The extraordinary fecundity of fish is remarkable, though it varies in different species, and this fact if properly considered by the pisciculturist, will lead him to devise means to increase the production of fish by protecting the eggs as well as by shielding the young and helpless fry from the many dangers which threaten them.

In the "Natural History of British Fishes" by Buckland many instances are given of the number of eggs found in gravid female fish. A few of these selected by Dunsford (1) are given here for comparison with the Punjab Fish.

Species of fish.	Weight.	Number of eggs.	Number of eggs per lb.
	lbs.		
Carp	14½	6,33,350	43,679
Carp	21½	13,10,750	60,965
Carp	16½	20,59,750	1,24,833
Pike	35	43,000	1,228
Pike	24	2,24,640	9,360
Cod	20	48,72,000	2,43,600
Trout	1	1,000	1,000



Fig. 1. NETTING FOR MURREL.



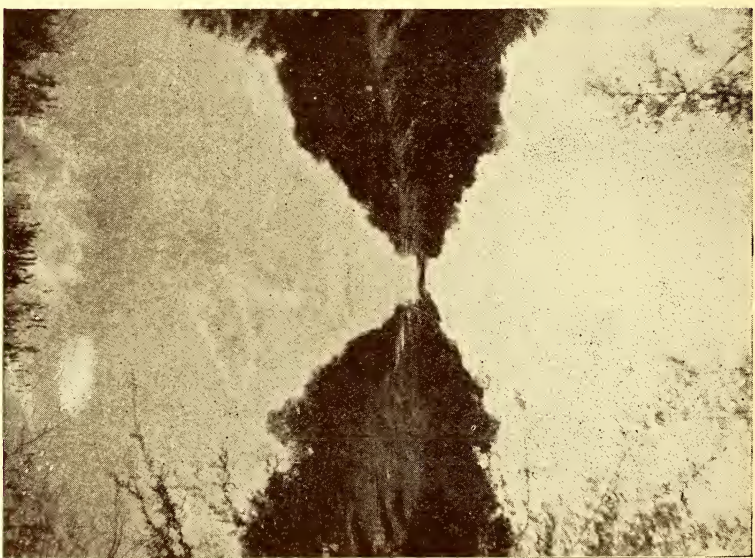
Fig. 2. Live Car for keeping Eggs and Fry under observation at Hatcheries.



Fig. 3. Tank at Sirkian for Murrel (*Ophio cephalidæ*) breeding.



CHHENAWAN FARM FOR CARP BREEDING.
1. Stock pond for breeders.



CHHENAWAN FARM FOR CARP BREEDING.
2. Stock pond for young fish.

All attempts to breed the members of the family *Cyprinidæ*, namely, *Labeo rohita*, *L. calbasu*, *Cirrhina mirgala* and *Catla catla* in artificial waters have proved failures. Unlike their western species they do not lay their eggs, even when brood fish from the river are introduced into the tanks. The experiment was tried at the Departmental Hatcheries at Madhopur but no result was obtained. One of the main reasons for our failure is the want of knowledge of their breeding habits in their natural environments.

The fish become ripe in May and both male and female seek shelter under weeds and aquatic plants near banks and are not easily frightened by the approach of intruders. Towards evening, groups of fish may be seen on the surface splashing water and fighting with each other. These are signs of courtship! And thus they wait for the first shower of rain. If there are no rains at all, or if they are late, the eggs degenerate in the ovaries, leaving a filthy mass. In July as soon as the rains set in, the streams become flooded and the fish move on to shallow waters. If the flood is of a temporary character they fall back into the main channel with the diminishing current without spawning, but if the floods are continuous the fish get into the surrounding fields, play together, lashing the water with their caudal portions. A female is often followed by three or more males, but reverse cases have also been observed. Very rarely are single couples seen. If a mate is separated from its companion or is companionless it has been heard to produce guttural sounds calling the other. This play lasts for only a short time and the female then lays its eggs which are non-floating and the males shed their seminal fluid or milt over or near them. Depth of water in fields where spawning takes place varies from three inches to two feet, and temperature of water ranges from 76° F. to 98° F. Sometimes when the flood subsides earlier, little pools are formed by the depressions and there the eggs are found in heaps.

The eggs are not laid at one place and at the same time, but at intervals during which the fish keeps on moving with its mates along with the current of water. The rivers are flooded first and the fish therein are the first to spawn, while those of the tributaries wait for heavy rains which flood them sufficiently to overflow into the fields where spawning takes place. The breeding time, thus, lasts from the beginning of July to the middle of August.

An egg measures from 1.5 m.m. to 2 m.m. but it swells to 4 m.m. as soon as it falls into the water due to the presence of a mucous like investment which gives it a glassy bead like appearance. The colour varies in different species: reddish in *Labeo rohita*, bluish in *L. calbasu* and *L. gonius*, light red in *C. mirgala*, dirty white in *C. reba* and yellowish in *Wallago attu*. Milt or male fluid is milky white, non-sticky and non-granular. The development is quickened by the warmth of the sun falling directly on the eggs lying in shallow waters and unlike their western species which hatch out toward the 12th or the 16th day, the embryo is seen bursting the eggs after 30 to 40 hours from the time of laying. There is very tiny yolk bag which is absorbed in three or four days. The mouth opens on the third day after hatching for respiration and two days after this, the young fry begin to seek their food in the diminutive pools where they have been left by their parents.

The extraordinary fecundity of these fish which is unparalleled in animal life is attended with enormous waste. The eggs are laid during floods which may carry them to places where their fate becomes uncertain. The male sheds its milt in water and there are very big chances of an egg being left unfertilized. The eggs either sink to the bottom or rest on grass attached by their gelatinous coats and there is every likelihood of the spawning fields drying up before they are hatched. If, however, they are lucky enough to escape all these misfortunes and are hatched in due time and find opportunity to run into a pool or stream, there their enemies do not leave them unmolested. Eggs of *Wallago attu*, a predaceous Siluroid and *Labeo gonius*, were collected from the same spot. They

hatched out at about the same time, but after a week the fry of *Labeo gonius* was 7 m.m. long while that of *Wallago attu* 20 m.m. and the latter were chasing the former and devouring them in large numbers; their mouths being big enough to catch two of the *Labeo* at a time. The rate of growth of *Wallago attu* fry is much faster than that of the Carp. In the latter the mouth opens twenty-four hours after hatching for respiration and the gut is completely formed after seventy-two hours. In *Wallago attu* the mouth opens within less than twenty hours and the gut is complete within forty hours after hatching and the fry begin to devour whatever comes in their way.

Even with such a loss and destruction of the eggs and fry the waters would teem with the finny tribe so long as man did not interfere with their normal growth by indiscriminate and untimely slaughter. The killing of one gravid female would mean the destruction of hundreds and thousands of eggs which otherwise under the most unfavourable circumstances would develop to continue their progeny. Observation of close season for fishing during breeding time will help the matter much, while establishment of hatcheries on scientific basis near the spawning grounds will ensure the development of eggs and fry and lessen the chances of their loss and destruction.

Barbus tor (Mahsir) differs from other members of the *Cyprinidæ* in as much as it is migratory in its habits. *Barbus tor* is seen in March and April ascending considerable heights and traversing long distances to get into the hilly tracts for spawning purposes. It has been said that these fish ascend to these hilly streams to find fresh feeding grounds or shallow waters best suited to the puny strength of their fry when hatched, and also that the parent fish drop back with the decreasing water, and therefore cannot return to devour their fry which are completely cut off till the next rainy season. But all this is true in a way regarding every other *Cyprinidæ* which spawn in the plains: therefore what accounts for the migratory habits of *Barbus tor*? In the case of Salmon, Roule (5) remarks "the habits of salmon are largely determined by the amount of oxygen dissolved in water. During the spawning season Salmon need the respiration intensified and therefore select and ascend rivers in which there is satisfactory proportion of oxygen." L. Crosswell commenting on this paper says "Salmon are driven to seek the gravel beds of the upper reaches of rivers, and trout the gravel beds of the lesser tributaries for spawning purposes, not only by their natural thirst for oxygen or their need of it in intensified respiration, but that their desire for the freshly aerated supply of water afforded by downward rushing mountain brooks, streams and rivers is fundamentally associated with the need of oxygen in oval development in and after spawning." He supports his statement with conclusions drawn from Loeb's experiments on artificial parthenogenesis, where fertilisation was initiated and development carried to the larval stage by means of cortical cytolysis followed by acceleration of oxidation in unfertilized eggs of molluscs and amphibians. Loeb came to the conclusion that the essential effect of the entrance of a spermatozoan into the ovum is also an acceleration of oxidation. Here is, then, the importance of oxygen in relation to the spawning of fish and the development of fry. Rapid flow of water brings volumes of oxygen in the downward rushing streams and *Barbus tor* travels up to get them. These fish were introduced into the ponds at Madhopur, but notwithstanding the submontaneous character of the place, they did not spawn as no rushing currents of water during rains stimulated them to lay their eggs.

In India pisciculture has almost been wholly neglected and in the Punjab it has never been seriously undertaken. The fecundity of fish is an established fact and the truth of this has been recognised in foreign countries where accordingly scientific methods have been devised to carry on fish culture. Study of the breeding habits shows that the Indian Carp can be made to spawn in ponds and tanks provided that all the conditions of their natural spawning